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PRELIMINARY OBSERVATIONS ON THE SOIL FAUNA ACTIVITY IN A *QUERCUS ILEX* WOOD

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Decomposition of the organic matter produced by a terrestrial ecosystem is a complex process in which both microorganisms and soil animals take part (Vannier, 1979). It is known that decomposers, such as Bacteria, Actinomyces and fungi, have the role of mineralising dead material produced by autotrophs and consumers (herbivores, carnivores, mycophages, bacteriophages). Proth (1978) claimed that even before leaf material has fallen to the soil the degradation process has already begun; the microflora sequence should be as follows: yeasts, fungi and bacteria (Reisinger and Kilbertus, 1975).

These organisms can move within the soil by passive transport or/and through the gut of microfauna. Thus, the complete transformation of organic matter is realized through a kind of symbiosis between microfauna and microflora.

Acarina and Collembola actively contribute to the reduction of the organic matter to very minute fragments so that it can be successively more easily attacked by microorganisms. We recall a study by Nef (1957) in which he reports the increase in surface area of a pine needle after mechanical fragmentation by soil fauna (from 180 mm to 1.8 m).

Rate of leaf breakdown and the role played by different trophic groups in this process vary greatly according to the species of plant and geographical position. Bocock and Gilbert (1957) established, for instance, that in northern England leaves of *Betula* lose almost 83% of their dry weight within six months; leaves of *Tilia* 55.6% and of *Quercus* leaves 17.4% to 26%. Inthe south of England, on the contrary, leaves of *Quercus* lose up to 90% of their dried weight and *Fagus* leaves 70% (Edwards and Heath, 1963). Similar studies, sometimes leading to different and contradictory results, were made by Witkamp (1966) and Heath *et al*. (1966) using different methods. One of the simplest was that used by Edwards and Heath (1963) who studied the rate of breakdown of *Quercus* and *Fagus* leaves; they used small bags having different mesh sizes. The results obtained by these authors showed that the breakdown of the organic matter is higher in the bags having larger meshes; that there is no differences between meshes of 1 mm and those of 0.5 mm; that each animal group attacks the leaves in a specific way; finally, that there is a precise sequence in organism activity: the enchytreids attack the leaves after they have been reduced to small fragments by Collembola and dipteran larvae.

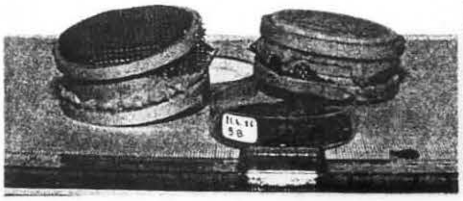

Fig. 1

Fig. 2

Fig. 1. Rings used for the experiments; Fig. 2. Partial view of the area in which the rings are buried. Note the number showing the position of one ring.

Other authors investigated the rate of decomposition of organic matter, using insecticides and radioactive markers (Kucheva, 1960; Witkamp and Crossley, 1966; Williams and Wiegert, 1971; Lee, 1974). More recently Stachurski and Zimka (1976), through a relationship between leaf surface, average caloric equivalent and loss of energy, established that the breakdown of the leaves of Alnus required energetic loss of 1880 K cal in a year; of these, 26.5% were due to microorganism activity and 73.5% to the consumption of the saprofitic fauna.

The aim of this study was to determine the rate of breakdown of oak leaves in the Siena region, in the park of the Castle of Celsa. For this purpose we selected an area of about 50 mq enclosed by a fence. We prepared 120 rings 4.5 cm in diameter and 2 cm high, covered by a 1.5 mm mesh and with a 75 μm mesh net underneath (Fig. 1). Each ring containing 1 g of discs of oak leaves, of a diameter of 1 cm, was previously maintained for 48 h at 50° C. The rings were numbered and buried 2 cm deep in the soil and covered with leaves (Fig. 2). The metereological data (temperature and humidity) of the locality were recorded by an instrument left on the site. In the diagram were reported the data (Fig. 3). Each month, starting from March 1986, we randomly dug up 10 rings from which we extracted the soil fauna with Berlese's apparatus. Attention was mainly paid to Collembola, even though we collected all the other soil organisms. After 20 days the discs within each ring were washed to remove small particles of soil, then dried for 48 h at 50° C, and weighed. The results are reported in the diagram (Fig. 4). They clearly show that there was a loss in weight of the leaf discs. The decrease, however, was not uniform, as reported by previous authors, but there seemed to be a general reduced activity of the soil organisms in May and August. A decreased number and variety of collembolan specimens was observed in the same periods. In April, in fact, we estimated a total number of 807 specimens (Fig. 5), while, in May, the total number was only 233, and in August 91 (Figs. 6 and 9). In June and July the decrease in weight of the leaves (Fig. 4) was in agreement with a greater number of collembolan specimens

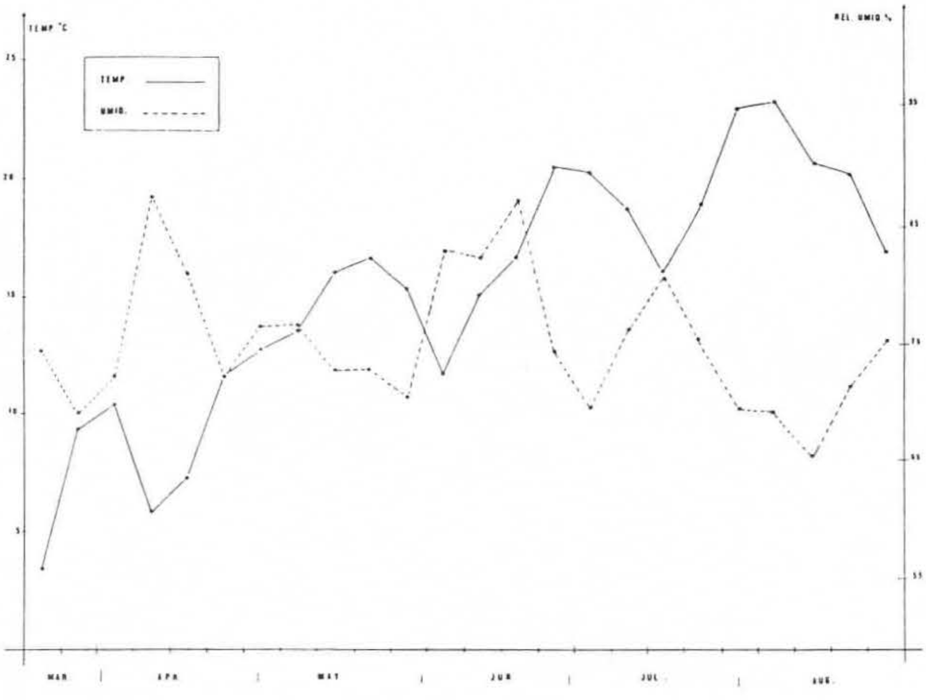

Fig. 3. Diagram of the metereological data.

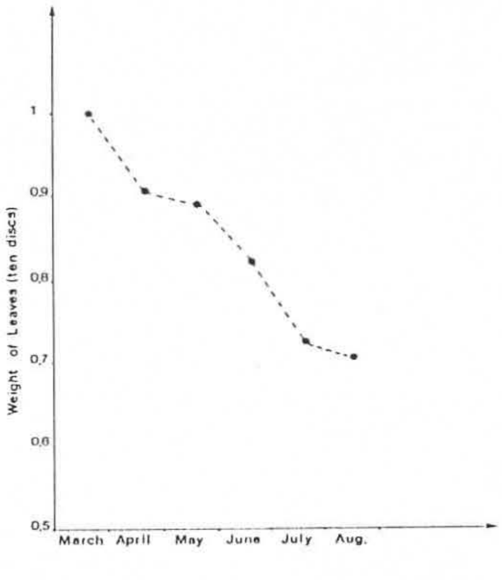

Fig. 4. Weight loss of leaf discs per time.

RINGS N°	21	28	42	56	59	64	78	93	99	120	
SPECIES											TOT.
Hypogastrura (C.) denticulata	24	15	30	35	9	90	74	20	13	44	354
Lathriopyga longiseta	-	-	-	-	-	1	-	-	-	-	1
Mesaphorura krausbaueri	-	-	1	-	-	-	-	-	1	-	2
Tetracanthella hygropetrica	-	-	1	-	-	-	-	-	-	-	1
Folsomia multiseta	-	-	1	1	-	2	4	-	-	-	8
Cryptopygus bipunctatus	2	4	1	1	3	2	-	8	1	1	23
Isotoma notabilis	32	14	10	15	12	16	8	12	10	10	139
Isotomurus palustris	-	-	-	1	-	-	-	-	-	-	1
Entomobrya multifasciata	-	-	-	2	-	-	-	-	2j.	5	9
Entomobrya nivalis	-	-	-	-	-	-	-	-	-	1	1
Orchesella villosa	-	-	3j.	-	-	1	-	-	-	1j.	5
Seira domestica	1	-	-	-	-	-	-	-	-	-	1
Heteromurus major	1	2	-	-	1	-	1	3	-	-	8
Lepidocyrtus lignorum	5	12	7	5	8	19	40	25	30	6	157
Pseudosinella apuanica	1	3	-	-	6	-	2	1	-	1	14
Megalothorax minimus	1	5	-	1	1	-	4	2	1	-	15
Sphaeridia pumilis	5	4	2	2	4	3	5	6	3	18	52
Arrhopalites sp.	-	-	-	-	1j.	-	-	-	-	1j.	2
Bourletiella sp.	-	-	-	-	-	2j.	-	-	-	-	2
Allacma gallica	-	-	7	-	-	1	1	-	2j.	-	11
Dicyrtoma sp.	-	-	-	-	-	-	-	-	-	1j.	1
											807

Fig. 5. List of the species found in April 1986

RINGS N°	2	18	24	26	45	49	74	83	102	116	
SPECIES											TOT.
Hypogastrura sp.	1	-	-	-	1	1	-	-	4j.	-	7
Bilobella aurantiaca	-	-	-	-	-	-	-	-	-	1	1
Tetracanthella hygropetrica	-	-	-	-	-	-	-	-	-	9	9
Isotomurus palustris	-	-	-	-	1	-	-	-	1		2
Entomobrya multifasciata	2	1	14	3	3	4	3		2	6	38
Entomobrya nivalis	-	-	-	1	-	-	-	-	-	-	1
Orchesella villosa	-	-	-	1	-	-	-	1	-	-	2
Seira domestica	-	3	2	1	2	7	2	-	3	-	20
Lepidocyrtus lignorum	5	10	1	5	15	-	5	-	4	1	46
Bourletiella sp.	-	-	-	-	-	-	-	-	1j.		1
Lipothrix lubbocki	-	2	1	-	-	-	-	-	-	4	7
Allacma gallica	5	35	4	20	4	7	4	3	10	6	98
Caprainea echinata	-	-	-	-	-	1	-	-	-	-	1
											233

Fig. 6. List of the species found in May 1986

(544 and 976 respectively) and variety of species (Figs. 7 and 8). We suspect that these results may be the consequence of an unusual trend of climate in those periods which did not favour the development of soil fauna and of the soil organisms in general.

It is well known that the soil fauna distribution is not uniform, but depends on the different microhabitats in the soil. We noted that except for the early period (April) when Podurids, mainly Hypogastrurids were predominant, in the other months Isotomids, Entomobryids and Symphypleona were the most common. This confirms that climate, even though it did not influence the vertical distribution of Collembola and other soil organisms (Vannier, 1973), favours the development of certain groups.

In April Hypogastrura denticulata was the most common species, but also Isotoma notabilis and Lepidocyrtus lignorum were well represented (Fig. 5). In May we noted a reduction of soil fauna; the most representative species in this period were Entomobrya multifasciata, Lepidocyrtus lignorum and mainly Allacma gallica (Fig. 6). In June we obtained again an increased number of species; Cryptopygus bipunctatus, Isotoma notabilis and Lepidocyrtus lignorum were the most represented (Fig. 7). A comparable situation was also observed in July (Fig. 8). In August

RINGS N°	5	32	39	53	66	70	80	89	107	109	
SPECIES											TOT.
Hypogastrura meridionalis	3	-	-	1	-	-	-	1	1	1	7
Hypogastrura sp.	1	1	-	1	2	1	2	3	2	1	14
Bilobella aurantiaca	-	-	-	-	-	-	-	-	-	1	1
Mesaphorura krausbaueri	1	-	2	-	-	-	1	-	-	-	4
Folsomia multiseta	6	1	5	4	1	1	1	2	-	5	26
Isotomiella minor	14	-	2	4	-	3	1	-	-	-	24
Cryptopygus bipunctatus	20	5	5	15	8	13	11	3	1	4	85
Isotoma notabilis	11	11	7	20	5	23	4	16	7	40	144
Entomobrya multifasciata	-	-	-	-	-	-	-	-	-	2	2
Entomobrya nivalis	-	-	-	-	-	1	-	-	-	-	1
Seira domestica	-	2	1	4	6	4	1	1	6	1	26
Hetromurus major	-	5	4	8	3	3	8	4	1	7	43
Lepidocyrtus lignorum	2	15	5	7	18	17	13	20	1	6	104
Pseudosinella apuanica	4	1	13	1	2	2	-	-	-	-	23
Megalothorax minimus	-	3	4	3	10	-	3	-	-	1	24
Sphaeridia pumilis	-	2	2	2	-	3	4	1	-	1	15
Arrhopalites sp.	-	-	-	-	-	-	1	-	-	-	1
											544

Fig. 7

RINGS N°	30	34	72	86	94	101	108	111	114	118	
SPECIES											TOT.
Hypogastrura meridionalis	-	-	-	-	1	-	-	1	-	-	2
Hypogastrura (C.)denticulata	-	-	-	-	-	-	2	-	-	-	2
Brachystomella parvula	1	-	-	-	2j.	1	-	-	-	-	4
Micranurida pygmaea	-	-	-	1	-	-	-	-	-	-	1
Lathriopyga longiseta	-	1	-	-	1	-	-	-	-	-	2
Mesaphorura krausbaueri	-	-	-	2	-	-	-	1	-	-	3
Folsomia multiseta	1	2	-	8	3	2	-	-	3	-	19
Cryptopygus bipunctatus	11	34	5	13	3	7	22	4	6	13	118
Isotomiella minor	6	6	-	-	-	-	-	-	-	-	12
Isotoma notabilis	15	82	16	40	28	-	85	18	12	74	370
Entomobrya nivalis	-	-	4j.	2j.	2j.	1	6	5	-	2	22
Orchesella villosa	-	1j.	1	2j.	-	-	-	-	1j.	1	6
Seira domestica	1	2	5	4	2	1	3	-	-	1	19
Heteromurus major	-	3	3	1	-	-	29	-	3	6	45
Lepidocyrtus lignorum	28	27	32	30	4	17	102	22	9	18	289
Pseudosinella apuanica	-	1	-	-	-	-	-	1	1	-	3
Megalothorax minimus	-	-	-	-	-	1	9	1	1	11	23
Sphaeridia pumilis	1	2	1	1	2	2	2	1	1	7	20
Arrhopalites sp.	-	-	-	-	-	1j.	-	4	-	-	5
Lipothrix lubbocki	-	2	-	-	2	-	-	-	-	7	11
											976

Fig. 8

there was a dramatic reduction of the collembolan fauna (Fig. 9).

It was interesting to note that, although many species typical of humus were well represented, those having a high value of ecological adaptation, such as *Isotoma notabilis*, *Lepidocyrtus lignorum* or *Cryptopygus bipunctatus*, were always abundant. The presence in May of a large number of *Allacma gallica*, an epygeic species related to *A. fusca*, may be in relation with the ability of the species to resist to dryness (Vannier, 1973). It was quite unexpected not to find more Onychiurids, because they are present in the soil fauna of the neighbouring region. As they are commonly found in winter, the reduced number of specimens in this group may merely depend on their rarity in the months we have till now considered for this study.

Because of the limited number of observations we cannot yet draw conclusions about the efficiency of the breakdown of oak leaves in the Mediterranean region. Nevertheless, considering that there was already a loss of weight of about 29%, it is likely that the breakdown proceeds normally.

Figs. 7 and 8. Lists of the species found in June (Fig. 7) and July (Fig. 8) 1986 respectively.

RINGS N°	10	15	36	47	55	68	77	86	91	106	
SPECIES											TOT.
Xenylla sp.	-	-	-	-	-	1	-	-	-	-	1
Isotomiella minor	-	-	-	-	-	-	1	-	-	-	1
Isotoma notabilis	-	4	-	-	2	5	5	-	-	-	16
Entomobrya muscorum	1	-	-	-	-	-	1	-	1	4	7
Orchesella villosa	-	-	2	1	-	-	2	-	-	-	5
Seira domestica	2	-	14	10	1	-	1	1	2	-	31
Lepidocyrtus lignorum	1	-	3	1	1	4	8	2	5	5	30
	-	-	-	-	-	-	-	-	-	-	91

Fig. 9. List of the species found in August 1986

We wish to thank the owners of the Castle for their generous hospitality.

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